

Computing Satellite Maneuvers for a Repeating Ground Track

Mathematical models account for all significant perturbations of the trajectory.

The TOPEX/POSEIDON Ground Track Maintenance Maneuver Targeting Program (GTARG) was developed to assist in designing maneuvers to maintain the orbit of the TOPEX/POSEIDON satellite. These maneuvers ensure that the ground track is kept within 1 km of a pattern that repeats exactly at intervals of approximately 9.9 days. Targeting strategies used by GTARG either maximize the time between maneuvers (longitude targeting) or force control band exit to occur at specified intervals (time targeting). A runout mode allows for ground-track propagation without targeting.

GTARG incorporates an analytic mean-element propagation algorithm that accounts for all perturbations that are known to cause significant variations in the ground track. These perturbations include the oblateness of the Earth, luni-solar gravitation, drag, thrusts associated with impulsive maneuvers, and unspecified fixed forces acting on the satellite in the direction along the trajectory.

The geopotential field is computed in GTARG by use of Merson's extension of Grove's theory. Kaula's disturbing function is used to include the luni-solar gravitational perturbations. GTARG includes a mathematical model of drag, unique to the satellite, that incorporates an approximate mean orbital Jacchia-Roberts atmosphere and a variable mean area model. Mathematical models of errors account for uncertainties in determination of orbits, errors in execution of maneuvers, unpredictability of drag, and use of the knowledge of fixed forces along the trajectory. Changes in velocity during maneuvers are targeted to maintain precisely either the unbiased ground track or a comfortable (three-standard-deviation) error envelope about the unbiased ground track.

GTARG is written in VAX-FORTRAN for DEC VAX computers running VMS. GTARG output is provided in two forms: an executive report summary in tabular form, and a plot file formatted as EZPLOT input namelists. Although the EZPLOT program and documentation are included with GTARG, EZPLOT requires PGPLOT, which was written by the Astronomy Department of the California Institute of Technology and is not available through COSMIC. GTARG users without access to PGPLOT may

therefore want to use a standard spreadsheet program to produce plots of the tabular ground-track data stored in the executive report summary. Alternatively, with the help of information found in the GTARG User's Reference Manual, the user can write a graphical interpreter program of his or her choice. The standard medium for distribution of GTARG is a 1,600-bit/in. (≈ 630 -bit/cm), 9-track magnetic tape in DEC VAX BACKUP format. It is also available on a TK50 tape cartridge in DEC VAX BACKUP format. GTARG was developed in 1993 and is a copyrighted work with all copyright vested in NASA.

This program was written by Bruce Shapiro of Caltech for NASA's Jet Propulsion Laboratory. For further information, write in 233 on the TSP Request Card. NPO-19257